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Improving the Methodology of Teaching the Science of Mathematical Analysis Based on SMART Technologies

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Abstract

In this article, research works on the use of smart technologies in teaching mathematics are studied. Studies of foreign scientists on the effectiveness of using Smart boards in mathematics lessons have been analyzed. The recommendations and practical works of the author on teaching the subject of mathematical analysis in higher education institutions based on smart technologies are shown through the topic “Limit of the function”. The main goal of the research is to improve students’ competencies through the use of computer simulation models in live demonstration of the processes taking place in the subject with the help of smart boards. The relevance of using modern educational technologies in the teaching of mathematics is based. In improving the teaching methodology based on SMART technologies, the topic "Limit of a function" of mathematical analysis was selected, theoretical information on the topic was presented, and computer simulation models were developed for some concepts and issues. Instructions on the practical application of the recommended teaching methodology are provided.

Keywords: mathematics, smart technology, methodology, computer simulation model, limit.

Introduction

The development of technologies is gaining importance in our daily life. These include smartphones, various gadgets, computers, and artificial intelligence technologies that help us in various fields today. Each of these tools, while performing certain functions, is becoming more convenient and "smart" for people to use. As a result of the discovery and improvement of modern technologies, many opportunities are being created in the field of education, as well as in many other fields.

Today, the use of blackboards and chalk in the educational process, tables with different textual forms, the use of various interactive methods to reinforce the topic, electronic textbooks, the use of slides prepared in the Power Point program are the main "methodology" of traditional education. organizes. At the time when technologies are improving every minute, it is becoming an urgent issue to interest young people in science and increase their creativity with this method. Below, unlike traditional education, the scientific research works conducted in foreign countries, where it is recommended to organize education using the teaching methodology based on smart technologies along with traditional education, are analyzed.

With the emergence of the concept of "smart", such concepts as smart boards, smart screens, and access to the Internet from anywhere entered the education system. Each of these concepts provides an

opportunity to reorganize the process of developing information content, delivering it to the student, and putting it into practice [4].

Senad Orhani's article entitled "The Contribution of the Smart Board to the Improvement of Learning Results in the Subject of Mathematics" aims to study the importance of using the Smart Board in improving the results of students in mathematics. Focusing on high school students, this study uses qualitative methodology to examine the contribution of technology to learning and student achievement. During the research, interviews were conducted with teachers and students, their perceptions and experiences of using the Smart board were revealed. The results make it possible to clearly consider the role and importance of the Smart board in mathematics classes, to solve possible problems and to make recommendations for the more successful use of this technology in education. This study extends the existing literature on the use of technology in education and provides a new perspective on the use of Smartboards in mathematics classrooms. The results of this research confirm that "Smart Board" has a positive effect on the process of learning mathematics and students' motivation. A detailed discussion of these points provides a rich and concise summary of the findings and their implications for the field of education.

According to teachers' evaluations and comments about Smartboards, it appears that there is a positive and significant relationship between the use of Smartboards and students' learning and motivation in mathematics. The teacher evaluates the contribution of the Smart board to the lesson as very positive and describes it as a new aspect added to the lesson. The use of multimedia materials made learning more interesting and made it possible to explain mathematical concepts more clearly. The teacher noticed that the students' activity increased significantly during the use of the smart board. When using this tool, students appear to be more engaged in mathematics, indicating a positive relationship between technology and their engagement in learning. A teacher finds a significant improvement in student performance after using a smart board. This improvement is due to better explanation and increased understanding of mathematical concepts. The smart board had a positive effect on student motivation. The use of multimedia methods and interesting teaching increased students' interest in mathematics. Interactive presentations and applications, especially those that use animation and case studies, are highly valued. This also increased activity and cooperation among students [2].

Methodology

A computer simulation model is an adequate (equated, suitable, similar) or approximate model of a real event and process based on computer programs. Showing the part of an event or process that cannot be explained in words through computer simulation models created on the basis of software allows the student to understand through imagination. One such tool is MS Power Point. In MS Power Point, animations can be used to distinguish an object from others on a slide.

Like many subjects, it is important to organize the teaching of mathematical analysis in higher education on the basis of effective and modern technologies. Today, in the teaching of mathematical analysis, teaching using blackboard and chalk technology or simple presentations created in the Power Point program is established. In this study, it is aimed to develop computer simulation models on each selected topic of mathematical analysis, unlike blackboard and chalk technology, and simple presentations created in Power Point software, and to demonstrate this process in a live, intelligent way for learning. That is, in order to reveal the content of the topic, it is necessary to show the processes taking place inside it and enrich it with sound. As a result, revealing the content of the subject is carried out in a lively way compared

to the blackboard and chalk technology. Such a teaching technology can be called a teaching method using SMART technologies [3].

Results

In this study, the teaching process based on SMART technologies in higher education is analyzed on the example of "Mathematical Analysis". The topic "Limit of a function" was chosen from the subject of mathematical analysis, and concepts and examples of this topic were explained based on animations created in Power Point.

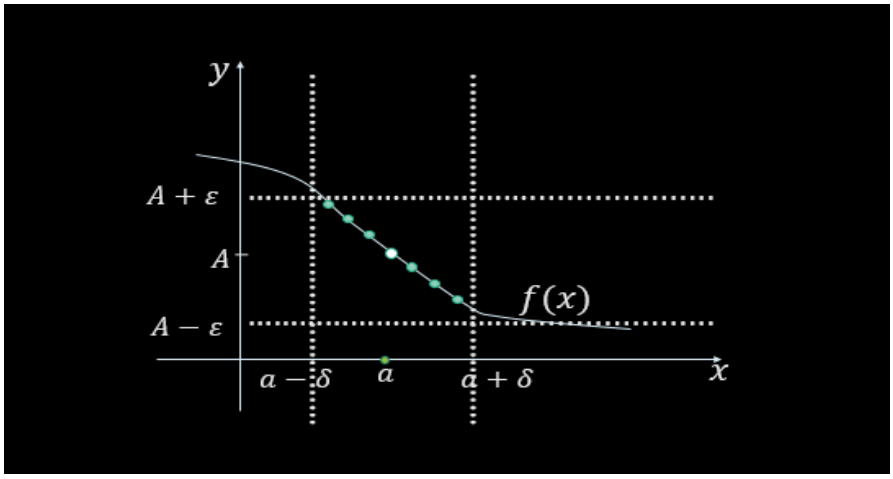
Mathematical analysis is a fundamental science, like other basic sciences, in the bachelor's programs in specific sciences of higher education institutions. Studying this subject, which is included in the curriculum from the first stage, is somewhat difficult for students. Below, we recommend an improved teaching methodology based on the visualization of the topic "Limit of a function", which is considered one of the important topics of the science of mathematical analysis.

Cauchy definition of the limit of a function. Let the function f be defined somewhere around the point a (it may not be defined at the point a itself). If the number $\exists\delta > 0$ is found for the number $\forall\varepsilon > 0$, then the inequality $|f(x) - A| < \varepsilon$ is fulfilled for x satisfying the relation $|x - a| < \delta, x \neq a$, then the function $x = a$ to the number A is called the limit at a point and $A = \lim\limits_{x\to a} f(x)$; sometimes $x \to a$ is defined as $f(x) \to A$. This definition is written in logical symbols as follows:

$$\left\{\lim_{x\to a} f(x) = A\right\} \Leftrightarrow \{\forall\varepsilon > 0, \exists\delta > 0, 0 < |x - a| < \delta, \forall x \in D(f) \to |f(x) - A| < \varepsilon\}$$

or using the concept of surroundings we write as follows:

$$\left\{\lim_{x\to a} f(x) = A\right\} \Leftrightarrow \left\{\forall\varepsilon > 0, \exists\delta > 0, \forall x \in U_\delta^0(a) \to f(x) \in U_\varepsilon(A)\right\} [1]$$



Picture 1. Visualization process of Cauchy's definition

According to Cauchy's definition, let's not take any x belonging to the neighborhood $U_\delta(a)$ of point a, the values of the function corresponding to these values also do not fall outside the neighborhood $U_\varepsilon(A)$ of the limit A of the function. In the process of visualization, it is aimed to increase students' competence by showing the model of the process that is difficult to imagine.

Heine's definition of the limit of a function.

If the function f is defined around a point a, that is, it is defined in the set $\exists\delta_0, U_{\delta_0}^0(a)$ and the terms $x_n \in U_{\delta_0}^0(a)$ let's not take an arbitrary sequence x_n that tends to a, if the sequence $\{f(x_n)\}$ composed of the values of the corresponding function tends to the number A, then the number A is called the limit of the function f at the point $x = a$, and $\lim\limits_{x\to a} f(x) = A$ is defined as [1].

Example 1. Show that the function $y = \sin\frac{1}{x}$ does not have a limit at $x = 0$ using Heine's definition.

Solving. There are sequences $\{x_n\}$ and $\{x_n'\}$ $(\forall n \in N, x_n \neq 0, x_n' \neq 0)$ approaching zero,

$$\lim_{n\to\infty} f(x_n) \neq \lim_{n\to\infty} f(x_n')$$

if we show that, according to Heine's definition, the considered function does not have a limit at point 0. Let $x_n = \frac{1}{\pi n}$ and $x_n' = \frac{1}{\frac{\pi}{2}+2\pi n}$. Clearly, $\lim\limits_{n\to\infty} x_n = \lim\limits_{n\to\infty} x_n' = 0$

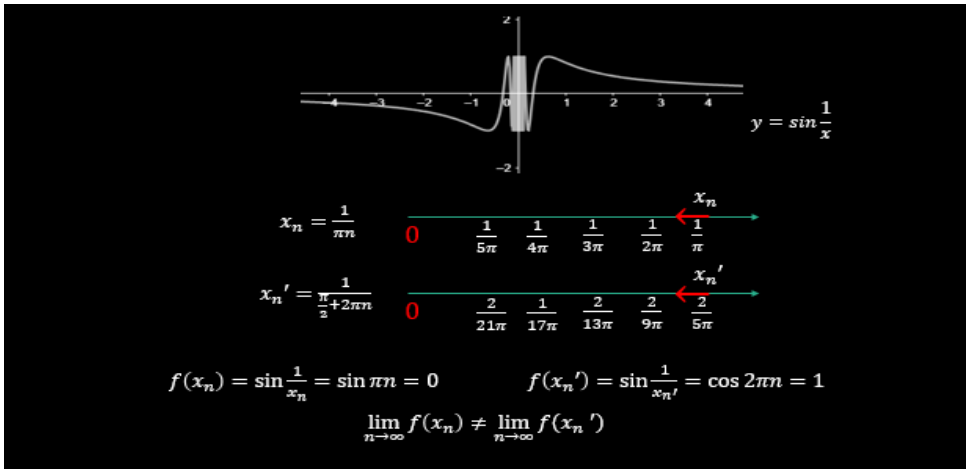
But in $n \to \infty$

$$f(x_n) = \sin \pi n = 0 \to 0,$$
$$f(x_n') = \sin\left(\frac{\pi}{2} + 2\pi n\right) = \sin\frac{\pi}{2} = 1 \to 1$$

relationships are appropriate. Thus, we get the following relation:

$$\lim_{n\to\infty} f(x_n) \neq \lim_{n\to\infty} f(x_n')$$

This shows that the function $\sin\frac{1}{x}$ does not have a limit at the point $x = 0$ [1].



Picture 2. Visualization process for example 1.

Discussion

The methods and methods used in the teaching of mathematics are mainly aimed at increasing the logical thinking of students. The use of SMART technologies in education helps to increase students' interest in science, to gain knowledge at any time, to imagine the processes taking place in the subject by seeing and hearing. Each visualization process developed from the science of mathematical analysis is not emphasized in traditional classes, takes too much time, does not take into account the capabilities of students who are difficult to master, and cannot be delivered through oral and written communication. It is important to include processes.

Conclusion

The use of information technologies, SMART technologies, innovative techniques and technologies in education serves to increase the knowledge, skills and qualifications of students. We believe that the use of the above-developed SMART technology-based teaching methodology of mathematical analysis along with the traditional methods used today will provide a wide opportunity to improve the quality of education and to provide students with a wider understanding of the processes taking place in the subject based on visualized models.

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